

# HOSPITAL RESPONSE TO RADIOLOGICAL INCIDENTS (An Overview)

Kansas Department of  
Health and Environment

Bureau of Air and  
Radiation



# WHY ARE WE HERE

Any hospital ER in Kansas has the possibility of receiving a patient who may be contaminated with radioactive material (RAM)

- Transportation Accidents where RAM was being transported
- Dirty Bomb or other Terrorism

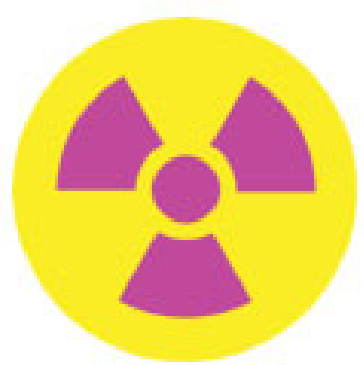
# WHAT WE'RE NOT TALKING ABOUT: IND (*Improvised Nuclear Device*)



# Topics to Be Covered Today

- Basic Radiation Concepts
- Role of the Hospital
  - Area Preparation
  - Equipment
  - Monitoring
  - Decontamination
  - Contamination and Exposure Control
  - Planning Considerations
  - Where to obtain additional assistance

# RADIATION!



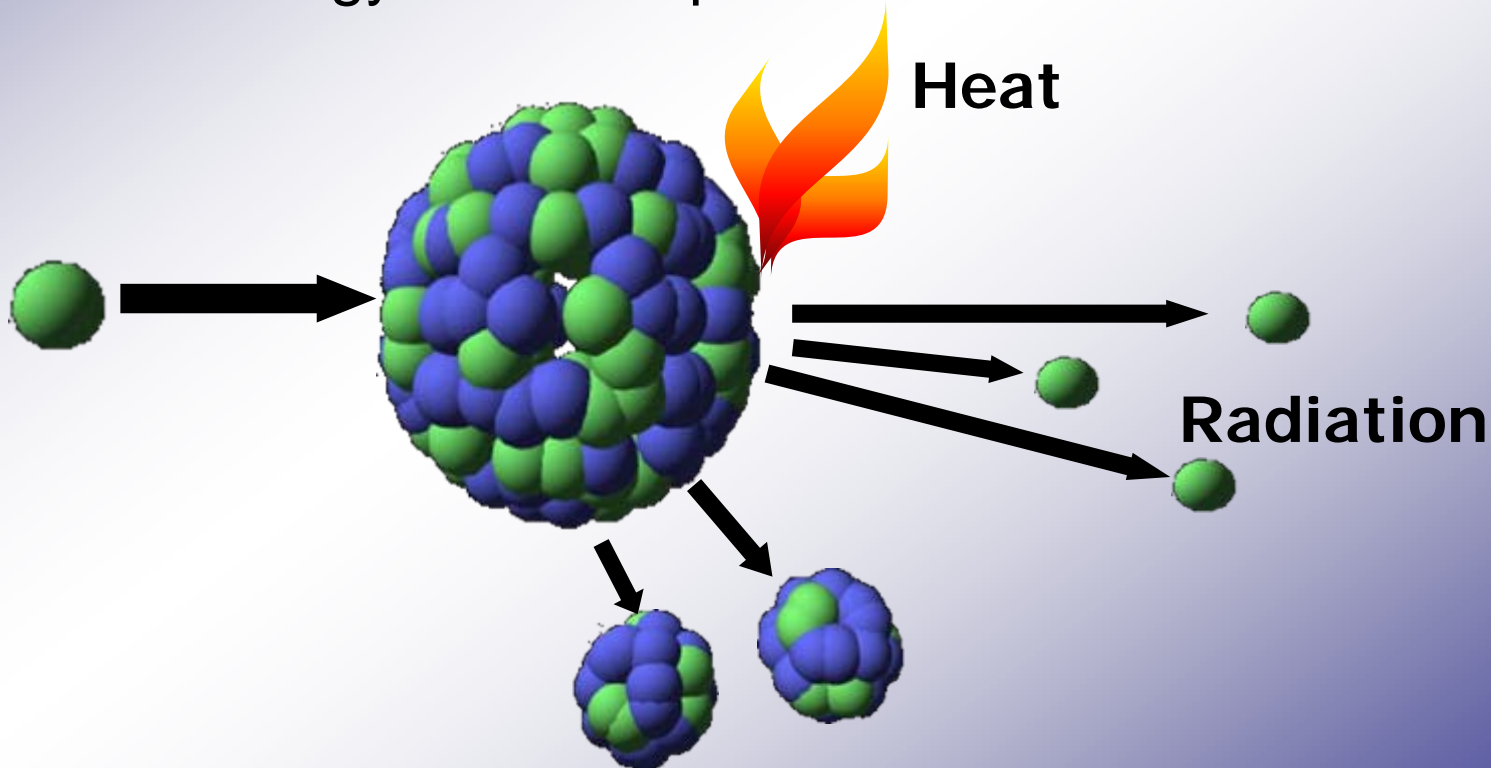
***What is it?***

***How does it affect you?***

***How do you work safely if it is  
present?***

# What is Radiation?

- Matter is composed of atoms. Some atoms are unstable. As these atoms change to become more stable, they give off invisible energy waves or particles called radiation.

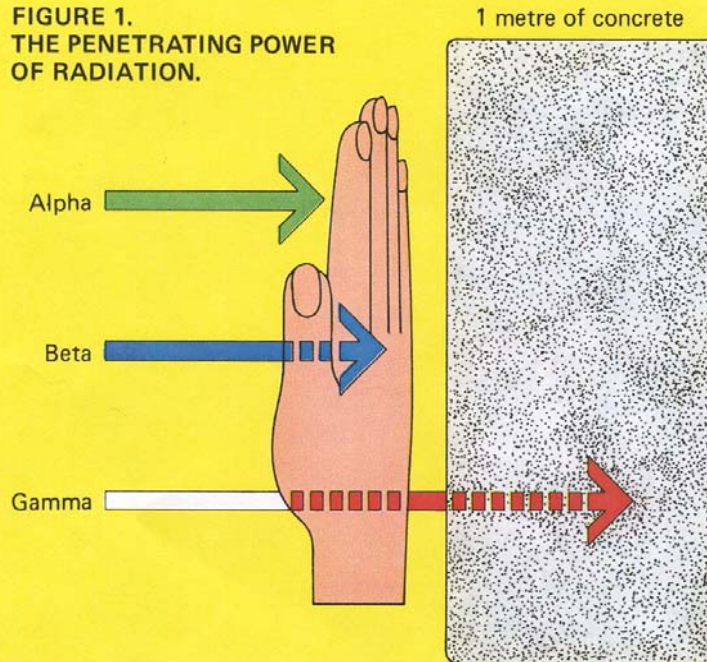




# TYPES OF RADIATION:

- Alpha
- Beta
- Gamma
- Neutron

FIGURE 1.  
THE PENETRATING POWER  
OF RADIATION.



## TYPES OF RADIATION

Although the term "radiation" is very broad and includes such things as light and radio waves, it is most often used to mean "ionizing" radiation, which is radiation that can produce charged particles ("ions") in materials that it strikes. This is true for inanimate as well as living matter; ionizing radiation then can represent a health hazard to man.

There are various types of ionizing radiation: alpha, beta and gamma radiation, X-rays and neutrons, each with different characteristics. Atoms that emit these kinds of radiation are said to be radioactive.

# RADIATION

## *Units of Radiation Measurement*

- rem (Roentgen Equivalent Man)
- Roentgen
- Rad (Radiation Absorbed Dose)
- cpm (Counts Per Minute)

*For our purposes:*

- 1 Roentgen = 1 Rem = 1 Rad
- 1 milliRoentgen = 1 milliRad = 1mR



# **RADIATION vs. CONTAMINATION**

Radiation is a type of energy.

Exposure to radiation will not contaminate you.

# CONTAMINATION

- When radioactive material is where it is not wanted (e.g., on the ground, in water, or on you) we refer to it as “contamination”

RADIOACTIVE CONTAMINATION  
EMITS RADIATION

# EMERGENCY WORKER EXPOSURE & PROTECTION

- ALARA (As Low As Reasonably Achievable)
- Time
- Distance
- Shielding
- DOSIMETRY
- KANSAS RADIATION EXPOSURE LIMITS
- Call-in limit ----- 500 mR
- Turn-back limit -----1000 mR or 1 R
- Limit w/o authorization - 5 rem

# RADIATION

**Annual Radiation Exposure  
Average of 375 millirem/year**

Source	Exposure
External Background Radiation	60 mrem/yr, U.S. Average
Natural K-40 Radioactivity in Body	40 mrem/yr
Air Travel Round Trip (NY-LA)	5 mrem
Chest X-ray Effective Dose	10 mrem per film
Radon in the Home	200 mrem/yr (variable)
Man-made (medical x-rays, etc.)	60 mrem/yr (average)

*Source: Health Physics Society*

# **RADIATION**

## **Effects from Exposure**

- Less than 25 Rem: No observable effects
- 25 to 100 Rem: Slight blood changes, no other observable effect
- 100 to 200 Rem: Vomiting may occur within three hours of exposure. Moderate blood changes are possible. Except for blood-forming system, recovery will occur in essentially all cases within a few weeks.

*Continued*

# **RADIATION**

## **Effects from Exposure**

- 200-600 Rem: Vomiting for most people occurs within three hours. Loss of hair after two weeks, severe blood changes, hemorrhaging and infection. Death may occur. The recovery period is one month to one year.
- Over 600 Rem: Vomiting occurs within one hour. Other effects include severe blood changes, hemorrhage, infection and hair loss. Probability of death is 80 percent (for 600 Rem) within two months. Survivors convalesce over a long period of time.



# ROLE OF THE HOSPITAL

- Treat the injury
- Monitor the patient for contamination
- Decontaminate

**IT SHOULD BE NOTED EMPHATICALLY THAT  
RADIOACTIVE CONTAMINATION IS **NOT**  
**IMMEDIATELY LIFE THREATENING** AND  
THEREFORE, A RADIOLOGICAL  
ASSESSMENT OR DECONTAMINATION  
SHOULD NEVER TAKE PRECEDENCE OVER  
SIGNIFICANT MEDICAL CONDITIONS.**

***NORMAL UNIVERSAL PRECAUTIONS ARE  
ADEQUATE TO PROTECT FROM  
RADIOACTIVE CONTAMINATION.***

# HOSPITAL SEQUENCE

- Radiation Emergency Area (REA) Preparation
- Staff Preparation
- Patient Arrival and Triage
- Medical Assessment and Treatment
  - *MEDICAL PROBLEMS HAVE PRIORITY OVER RADIOLOGICAL CONCERNS*
- Radiological Assessment
- Decontamination



# Preparation of REA



**With Herculite**



**Without Herculite**



# Preparation of REA



# STAFF PREPARATION

## *Protective Clothing*

- Surgical Scrubs
- Protective Shoe Covers
- First Pair of Gloves
- Gown
- Second Pair of Gloves
- Cap and Mask





# Protective Clothing



# Dosimetry and Emergency Worker Exposure Protection





# Staff Preparation



# Patient Arrival & Triage





# Monitor Ambulance, Equipment and EMT's



# Return to normal as soon as possible!



## What if you find contamination?



# ROLE OF THE HOSPITAL

- Treat the injury
- Monitor the patient for contamination
- Decontaminate

May need to monitor large numbers of people



More than 100 volunteers from Johnson County, Iowa, participated at a reception center drill as center staff and evacuees.

**David Teska/FEMA News Photo**

# Where to put large numbers of potentially contaminated citizens

- **PLANNING:** Identify the best area for mass monitoring and decontamination. Is it at the hospital?

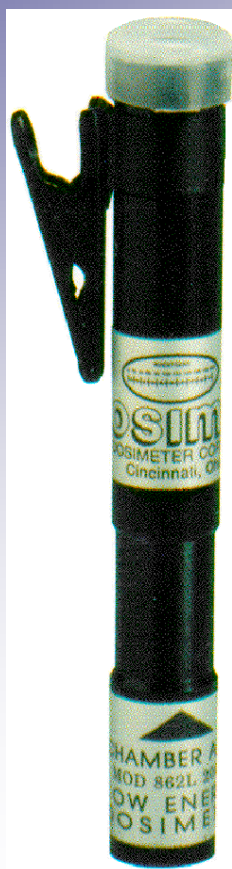
# Does Hospital have Equipment and Supplies?

- Inventory of Nuclear Medicine Meters
- Dosimetry is a MUST
- Portal Monitor
- Decontamination Bed (for most severely injured)
- Decontamination Tents (or area with showers)

# Minimum Radiological Instrumentation Needed

- Dosimetry
- Survey Meters
- Portals Monitors?

# Dosimetry is a MUST





# RECOMMENDED DOSIMETRY

- Low range direct-reading
  - (scale in mR or R up to 2R)
- Permanent Record Dosimeter
- Method to record and track exposures

Record reading at least once an hour.

Recharge dosimeter when it reaches 3/4 scale.  
Check with supervisor for location of nearest charger.

Notify your supervisor immediately if:

1. Your dosimeter hairline has gone off-scale or is not visible, or
2. You have reached the exposure limits:

**500 mR** call-in limit  
(Call supervisor)

**1 R** (1000 mR) turn-back limit  
(Leave area, call supervisor)

Exposures of 5 R (5000 mR) or higher must be officially authorized.

Potassium iodide (KI) will be at access control points or transported to workers from the County E.O.C. or Wolf Creek, if needed.

#### DAILY INDIVIDUAL RADIATION EXPOSURE RECORD

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

HOME PHONE \_\_\_\_\_

SS# \_\_\_\_\_

BIRTHDATE \_\_\_\_\_

ORGANIZATION \_\_\_\_\_

TODAYS DATE AND TIME \_\_\_\_\_

Direct-Reading Dosimeter Serial Numbers:

Low (Any w/scale in mR) \_\_\_\_\_ Range 0-\_\_\_\_\_

Low (Any w/scale in R up to 2R) \_\_\_\_\_ Range 0-\_\_\_\_\_

Mid (Scale in R - 2R up to 20R) \_\_\_\_\_ Range 0-\_\_\_\_\_

High (Scale in R over 20R) \_\_\_\_\_ Range 0-\_\_\_\_\_

TLD Serial Number \_\_\_\_\_

Revised 9/99

# Daily Individual Radiation Exposure Record

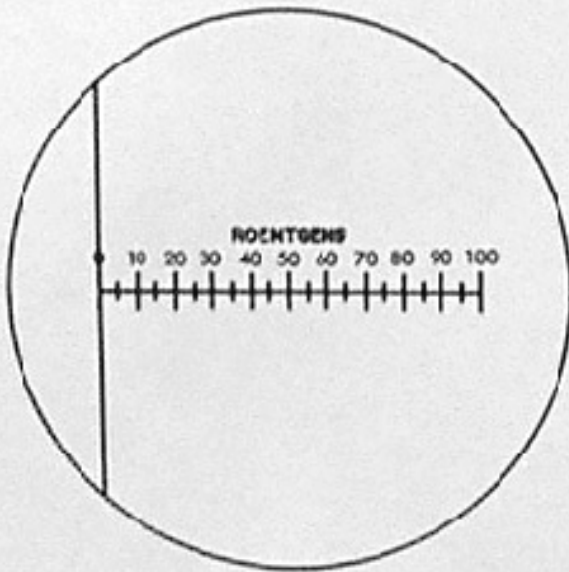
	Low Range Dosimeter Exposure Reading	Low Range Dosimeter Exposure Reading	Mid Range Dosimeter Exposure Reading	High Range Dosimeter Exposure Reading
Time Read	Current-Previous=Total	Current-Previous=Total	Current-Previous=Total	Current-Previous=Total
	- = mR	- = R	- = R	- = R
	- = mR	- = R	- = R	- = R
	- = mR	- = R	- = R	- = R
	- = mR	- = R	- = R	- = R
	- = mR	- = R	- = R	- = R
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	- = mR	- = R	- = R	- = R

(The line below is to be filled out by Coffey County Radiological Officer  
or Kansas Department of Health and Environment)

EXPOSURE RECORDED TODAY \_\_\_\_\_

# DOSIMETRY

## *CHARGING DOSIMETERS*





# Try not to overwhelm a victim with monitors





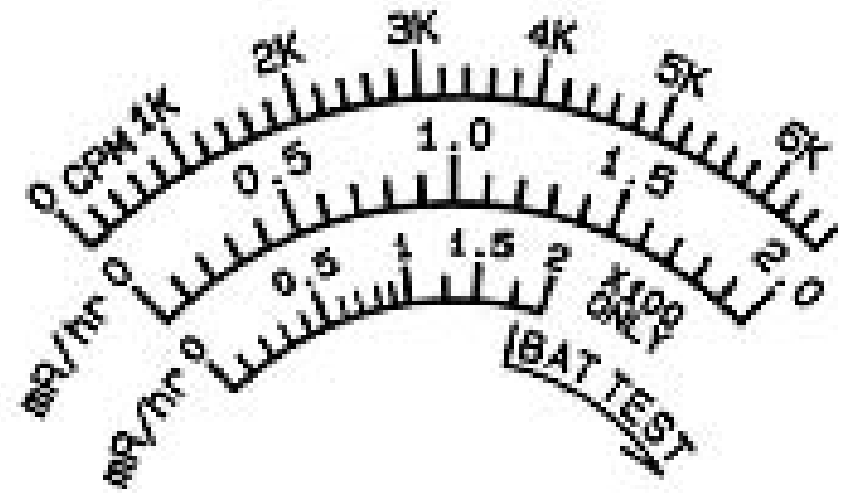
# Survey Meters



# Ludlum 14c



# Ludlum 14c



202-608



# Survey Meter

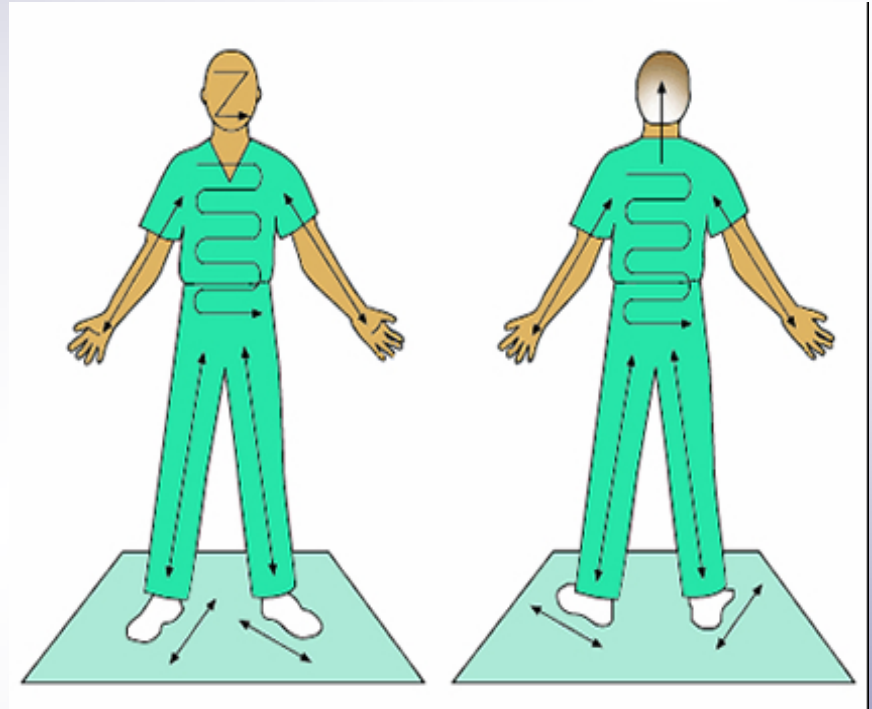
- Check Calibration Date
- Instrument Operational Check
- Determine Background Radiation Levels
- Determine Contamination Level
- Survey Technique
  - Open Window
  - Cover Probe

# ***Survey Technique***



# Contamination Surveys

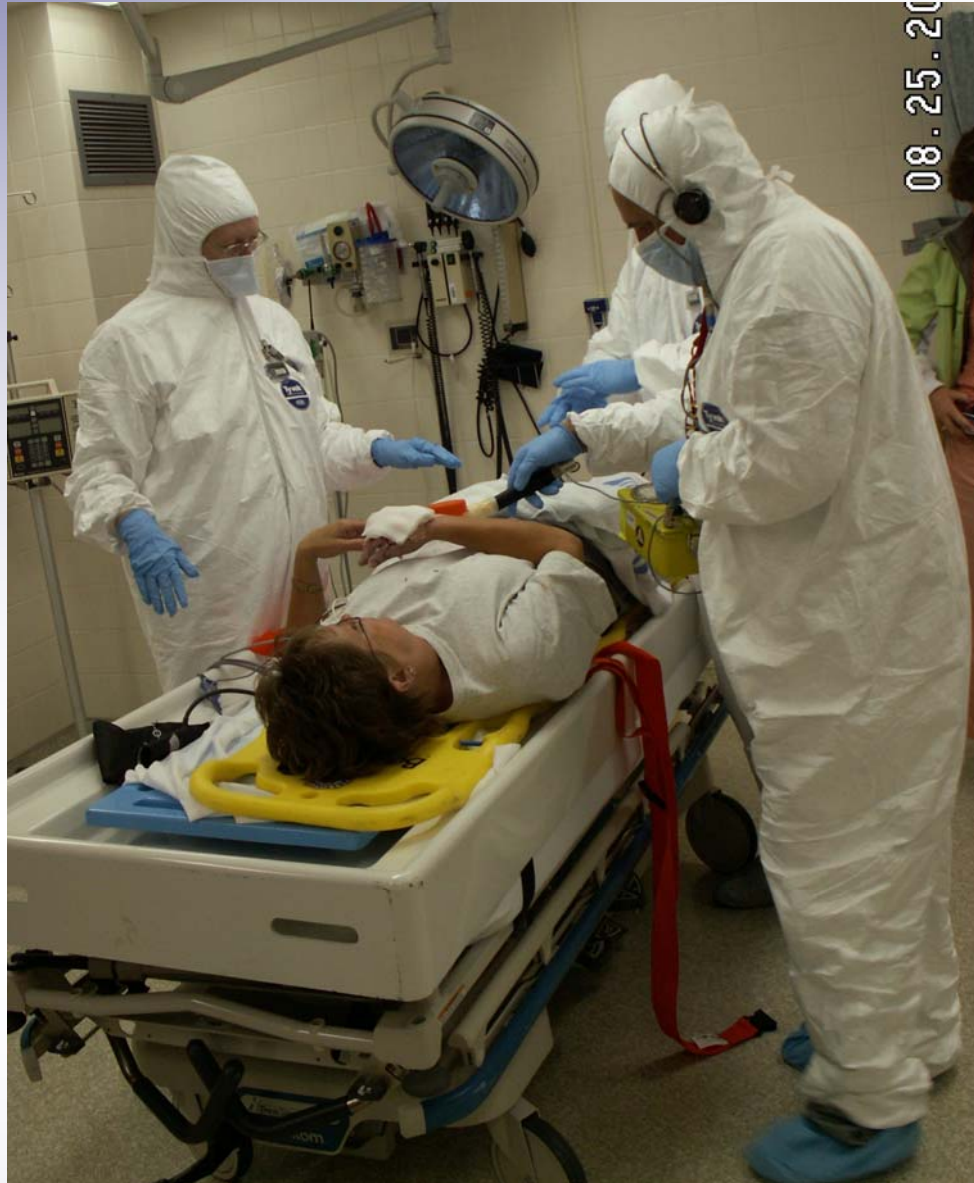
- Use nuclear medicine and radiation therapy technologists (familiar with use of instruments)
- Document and Survey



REACT/TS

- Probe held ~ ¼ to 4" from surface
- Move at a rate of 3 to 6" per second (dependent upon probe & instrument)
- Follow logical pattern
- Document readings in counts per minute (cpm)

# Survey Technique



# Portal Monitor





# Medical Assessment, Radiological Assessment & Decontamination



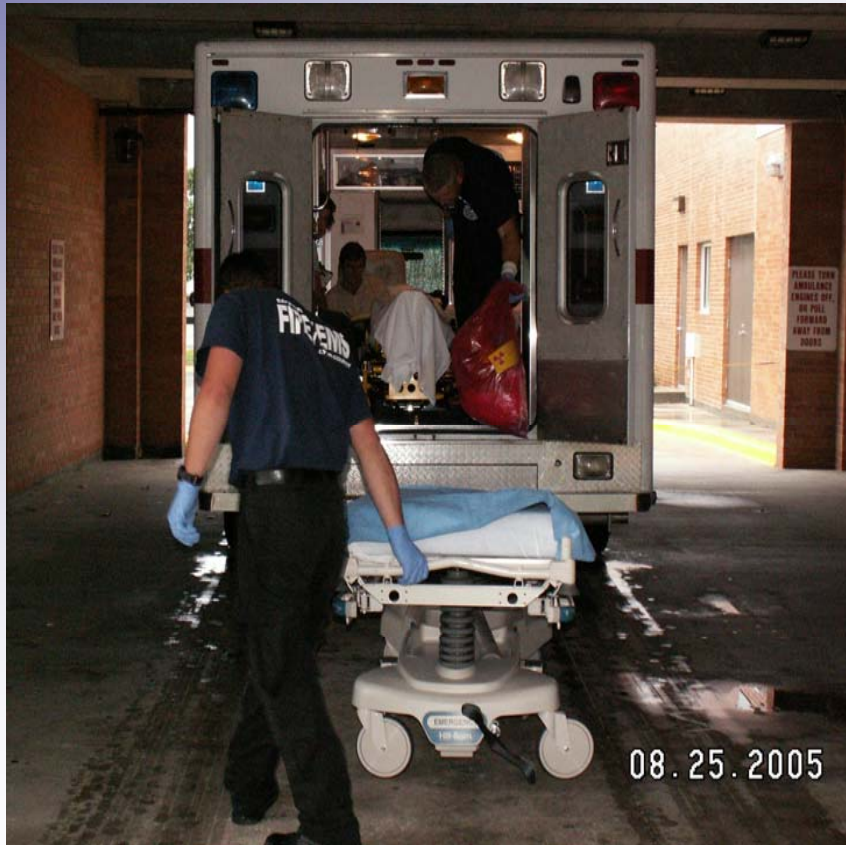
# Role of the Hospital

- Treat the injury
- Monitor the patient for contamination
- Decontaminate



# Transportation Accidents

(Only a few individuals may be contaminated)



# DIRTY BOMB

Mass Casualties, Contaminated but  
Uninjured People, and Self Presenters





# In Field Mass Decontamination **NOT RECOMMENDED**



# Not Recommended



**While this might be acceptable for the emergency workers and first responders on scene, don't do this with the general public.**



# Not Recommended



**Avoid any recreation of the “shower scene” from the movie *Silkwood* - no aggressive scrubbing!**

# Decontamination Methods

- Removal of clothing will typically remove 90% of the contamination
- Warm water alone or water with gentle soap will decon most skin contamination
- If they really need a decon shower – they should be allowed to wash themselves, assisted, if necessary.
- Soap and water, rinse, dry off, then re-monitor. Afford some privacy.
- Back to the shower if they don't get it the first time.
- If it continues to be a problem, seek additional assistance (KDHE).

# Decontamination Techniques





# Decontamination Techniques



# DECONTAMINATION

- EXTERNAL
- INTERNAL
- RADIO-PROTECTIVE DRUGS

# FDA Approved Radiation Countermeasures

- Potassium Iodide (KI)
- Prussian Blue
- Ca-DTPA and Zn-DTPA

# Potassium Iodide (KI)

- Prophylaxis against uptake of Radioactive Iodine (not likely to be needed for a dirty bomb)
- Dosing (Supplied as 65 or 130 mg tablet – no prescription required)
  - 18-40 yr: 130 mg/day
  - 3-18 yr, pregnant/lactating: 65 mg/day
  - 1 mo-3 yo: 32 mg/day
  - Birth to 1 mo: 16 mg/day
- KI Shelf-life is 5 years
- 90% effective if taken before or concurrently with exposure. 50% effective 4 hours after exposure. Some limited effect 12 hours after exposure.

# Prussian Blue (Radiogardase™)

*For the treatment of known or suspected internal contamination with radioactive cesium, radioactive thallium only. (It binds and reduces GI re-absorption-speeds up the excretion from the body)*

- Should be taken as soon as possible after exposure. It is still effective even after time has elapsed since exposure.
- Side effects: gastric distress (constipation and upset stomach)
- Dosing (available only by prescription)
  - Supplied as 500 mg tablet
  - Adult: 3 g three times a day for 30 days
  - Children 2-12 yo: 1 g three times a day for 30 days



# Ca-DTPA and Zn-DTPA

(pentetate calcium trisodium injection and pentetate zinc trisodium injection)

- For treating internal contamination with plutonium, americium, or curium (Pu, Am, Cm).
- Increases rate of elimination from the body
- Ca-DTPA should be given as the first dose. If additional treatment is needed Zn-DTPA should be used.
- Dosing
  - Adult: 1 g Ca first day + 1 g Ca/Zn following
  - Pediatric (<12 yo): 14 mg/kg Ca; 14 mg/kg Ca/Zn
- Routes of administration: Usually administered into the blood stream. However, for people who only have contamination by inhalation, they can be administered by nebulized inhalation.
- Side effects: Ca-DTPA: loss of certain essential nutritional metals such as zinc (take oral zinc supplements). Less effect with Zn-DTPA. Breathing difficulties have been noted in some of those treated by inhalation therapy.

# REAC/TS

The Radiation Emergency Assistance Center/Training Site maintains a specially trained team of physicians, nurses, health physicists, radiobiologists and emergency coordinators. This team is prepared to provide 24-hr assistance on either the local, national, or international level in the medical management of radiation accidents.



# Mass Decontamination Tents





# Decontamination Tent



**Location: Do you have a water source?**





# Not Recommended

- **Ladder trucks and fogger nozzles**
- **Cold tap or hydrant water**
- **Showering in clothing**
- **Responders scrubbing down the public**

# OTHER CONCERNS

- Prevent contamination of hospital
- Avoid unnecessary exposure to hospital staff
- Does hospital have sufficient equipment and supplies?
- Is hospital staff trained on radiological issues?
- Where to put large numbers of people?
- Psychological issues

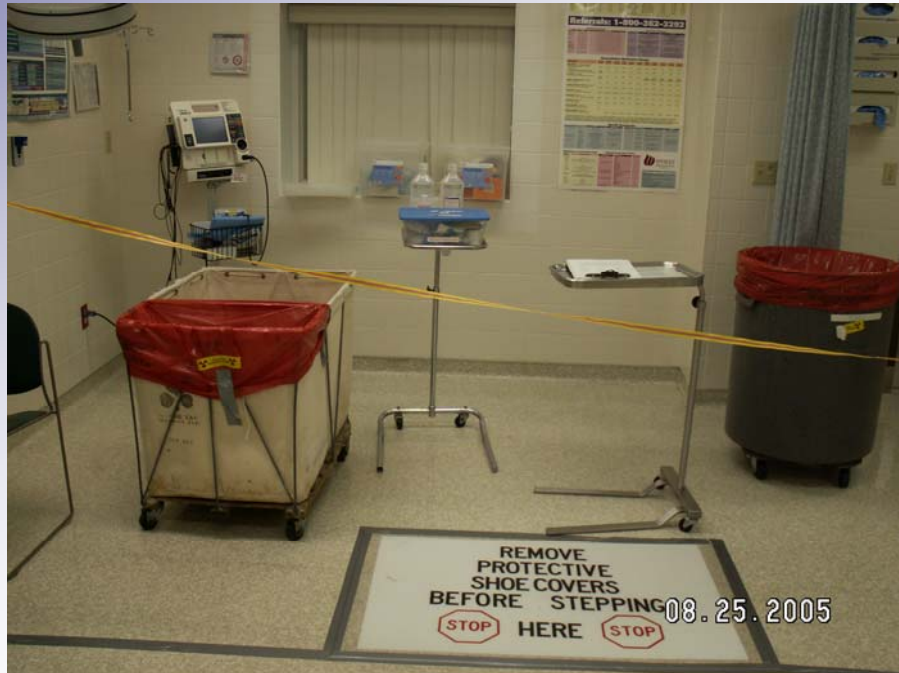
# Prevent Contamination of Hospital

- Isolate area – set up perimeter
- Monitor anyone leaving the area
- Booties/Gloves/Protective Clothing
- Periodically monitor the floor
- Remember: Contamination is not life threatening and can be easily cleaned up.
- WILL NOT HAVE TO SHUT DOWN HOSPITAL DUE TO RADIOACTIVE CONTAMINATION

# Contamination Control



# Contamination Control





# Contamination Control



# X-RAY



# HOSPITAL SEQUENCE

## *Continued*

- Final Survey
- Patient Transfer and Exit
- Ongoing Contamination Control
- Attendant Exit





# Final Survey and Patient Exit

- Final Survey in treatment area followed by patient exit and survey...



# Staff Exit





# Staff Exit



# Final Survey of Staff



QUESTIONS

THANK YOU

